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# INSTRUCTION MANUAL
# MODEL 800B

## RELATIVE HUMIDITY
## and
## TEMPERATURE INDICATOR

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## 1.0 DESCRIPTION

### 1.1 General

The Model 800B Relative Humidity and Temperture Indicator is a very accurate and reliable portable instrument utilizing a bulk resistance type polymer humidity sensor for relative humidity detection and a thermistor for temperature measurement.

The instrument is easy to operate and features fast response, a wide measurement range for temperature and humidity, high accuracy, stable operation, temperature compensation and a built-in battery for operation on battery or line voltage. An optional selector unit, the Model 802, is available for multi sensor operation (up to 5 channels).

The instrument is supplied with a leatherette carrying case capable of storing the instrument, sensor, cables and manual.

### 1.2 Sensor

The sensing element is a bulk resistance type humidity sensitive polymer. Imbedded in the polymer is an interdigitated anode/cathode grid. As molecules of water are absorbed or desorbed into the polymer, the resistance to current flow is altered. Each element is calibrated and electronically compensated to provide continuous, linear voltage outputs. The polymer is impervious to most contaminants. Since it is a bulk resistance device, surface contamination such as dust will not alter the accuracy of the readings.

### 1.3 Indicator

The electronics are contained in a rugged, steel housing designed for continuous service. The electronic circuit measures both relative humidity and temperature. Continuous temperature compensation adjusts for temperature induced changes in the RH sensor output. Such errors are present in all RH sensing elements and introduce considerable error unless temperature is compensated. The compensation present in the 800B instrument provides excellent measurement accuracy over the operating temperature range of the instrument.

## 2.0 SPECIFICATIONS

1. OPERATING TEMPERATURE AND HUMIDITY RANGE:

| | |
|---|---|
| Indicator Unit and Sensor Electronics Unit: | 0-50°C and less than 90%RH* |
| Probe (Sensor section): | -10°C to +80°C, 99.9%RH Maximum* |

2. MEASUREMENT RANGE:

| | |
|---|---|
| Temperature | -10 to +80°C* |
| Humidity | 10-99.9%RH |

3. ACCURACY

| | |
|---|---|
| Temperature | ±0.5°C |
| Humidity | ±2% RH at 25°C (±1% over wide range)<br>±3% RH over most of range at 0-50°C |

4. SENSOR ELEMENT

| | |
|---|---|
| Temperature | Thermistor |
| Humidity | High sensitivity Polymer Type RH-8<br>(Bulk resistance measurement) |

5. RESOLUTION

| | |
|---|---|
| Temperature | 0.1°C |
| Humidity | 0.1% RH |

6. DISPLAY — 3-1/2 digit LED display

7. SAMPLING — 3/sec

8. HYSTERESIS — Negligible

9. ANALOG OUTPUT — Temperature and %RH, simultaneous outputs.

   Output Range — 0-10mVDC ) 0-100mVDC ) Selectable 0-1VDC )

10. PROBE — Model 810, 811, 812, 813 or 814

11. POWER SOURCE — 2-way Power Source
    1. 115VAC 50/60Hz
    2. Built-in battery

    Operating time: 8 consecutive hours for battery (when fully charged)
    Charge time: 15 hours
    Battery: NiCD (1.2V) x 5

| | | |
|---|---|---|
| 12. | POWER CONSUMPTION | Approximately 4W |
| 13. | WEIGHT (MAIN BODY) | Approximately 5 lbs. (2kg) |
| 14. | CARRYING CASE (STANDARD) | Can store Instrument, Power cord, Instruction Manual, Sensor Cable (5 ft. standard), and 810, 813 or 814 sensor. |

* The RH-8 Sensor element (probe top) can be used at temperatures up to 80°C. The sensor electronics unit (integral in Model 810 probe, mounted on opposite end of probe in Models 811 and 812 and mounted in separate sensor electronics unit in Models 813 and 814) can be used at temperatures up to 50°C.

**COMMENTS**

1. HYSTERESIS

   As indicated above, hysteresis of the Polymer type sensors is negligible. If the relative humidity increases rapidly from say 20% to 90% and then drops from 90% back to 20%, the reading at 50% RH may be as much as 1% higher on the return swing than when the humidity was going up. However, this represents a time delay rather than hysteresis. If the relative humidity were to stay at 50%, the reading would drop to virtually the same reading as during the upswing, within 10 minutes. Any deviation represents a time delay rather than hysteresis.

2. As shown in Figure 1, the accuracy is within 1 to 2% over the range of 10 to 90% RH at an ambient temperature of 25°C (75°F). Temperature compensation is provided in the range of 0 to 50°C. As a result the accuracy can be maintained over the temperature range within about ±2% over a span of 40% to 90% and ±3 to 5% below 40% RH and above 90% RH. Over the indicated temperature span, these accuracies are better than available in almost any other commercial instrument.

## 3.0 SENSOR (MACRO-MOLECULAR HUMIDITY SENSOR, (TYPE RH-8)

### 3.1 General

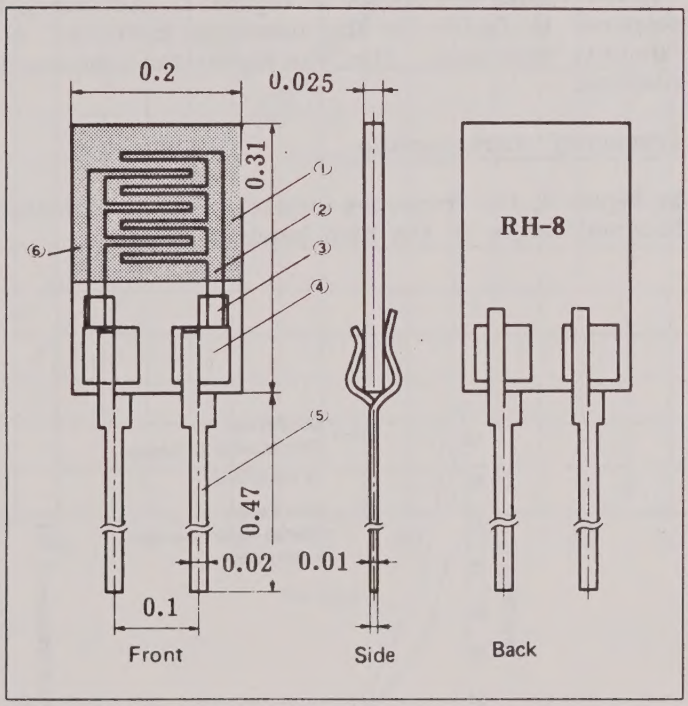
The RH-8 humidity sensing element is composed of an electrode base-plate coated with a humidity sensitive macro-silicone polymer. The resistance of the electrode varies according to the change in relative humidity.

The humidity sensitive material is prepared by polymerizing a solution of quaternary ammonium bases and the reaction of this functional base with a silicone resin. This produces a three-dimensional thermosetting resin which is characterized by its excellent stability in extreme conditions.

### 3.2 Operating Principle

Humidity is measured by change in resistance between anode and cathode. When the quaternary ammonium salt contained in the electrode shows ion conductivity caused by the presence of humidity mobile ions in the film are created. The more the humidity in the atmosphere increases, the greater the ionization becomes, and as a result, the concentration of mobile ions increases. Conversely, when humidity decreases, ionization is reduced and the concentration of mobile ions decreases. In this way, electrical resistance of the humidity sensitive film responds to changes in humidity absorption and desorption. The movement of such ions is measured using the variation in impedance caused by changes in humidity. Contrary to the Pope Cell which is a surface resistive element, the RH-8 is a bulk effect sensor where the bulk resistivity of the surface film is related to the Relative Humidity.

External Dimensions and Construction Dimensions are in inches.




1. Base material
2. Gold electrode
3. Overcoating
4. Ag-Pd electrode
5. Lead Frame (soldered)
6. Humidity sensitive material

### 3.3 Electrical Characteristics of RH-8 Sensor

1. Humidity resistance characteristics:

Figure 1 shows relative humidity resistance characteristics. The characteristics are stable even when low and high humidity are repeatedly and continuously measured. (1V, 1kHz)

2. Hysteresis characteristics:

Hysteresis is defined as the difference between the characteristic in moisture absorption and desorption as a result of changes in relative humidity. Its value is less than 0.1% R.H.

3. Response characteristic:

Typical values are shown in Figure 2. According to this graph, the response is faster as the humidity increases, compared to when humidity decreases. Also, the higher the temperature, the faster the response.

4. Frequency characteristic:

In Figure 3, the frequency characteristic is indicated. The difference becomes larger in the high humidity range.

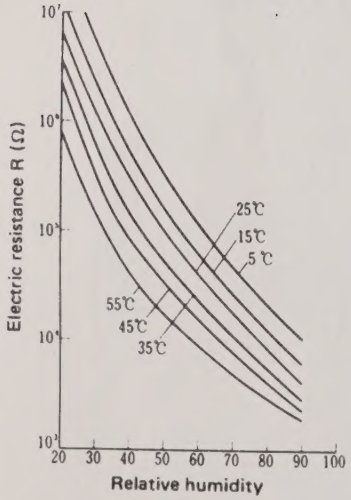



Fig. 1 Resistance Characteristics to Relative Humidity and Temperature

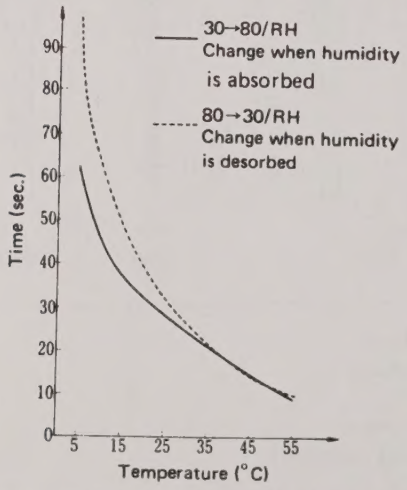



Fig. 2 Relationship between Temperature and Responsiveness (80% Change)

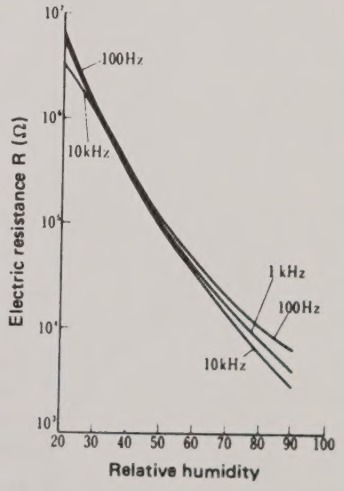
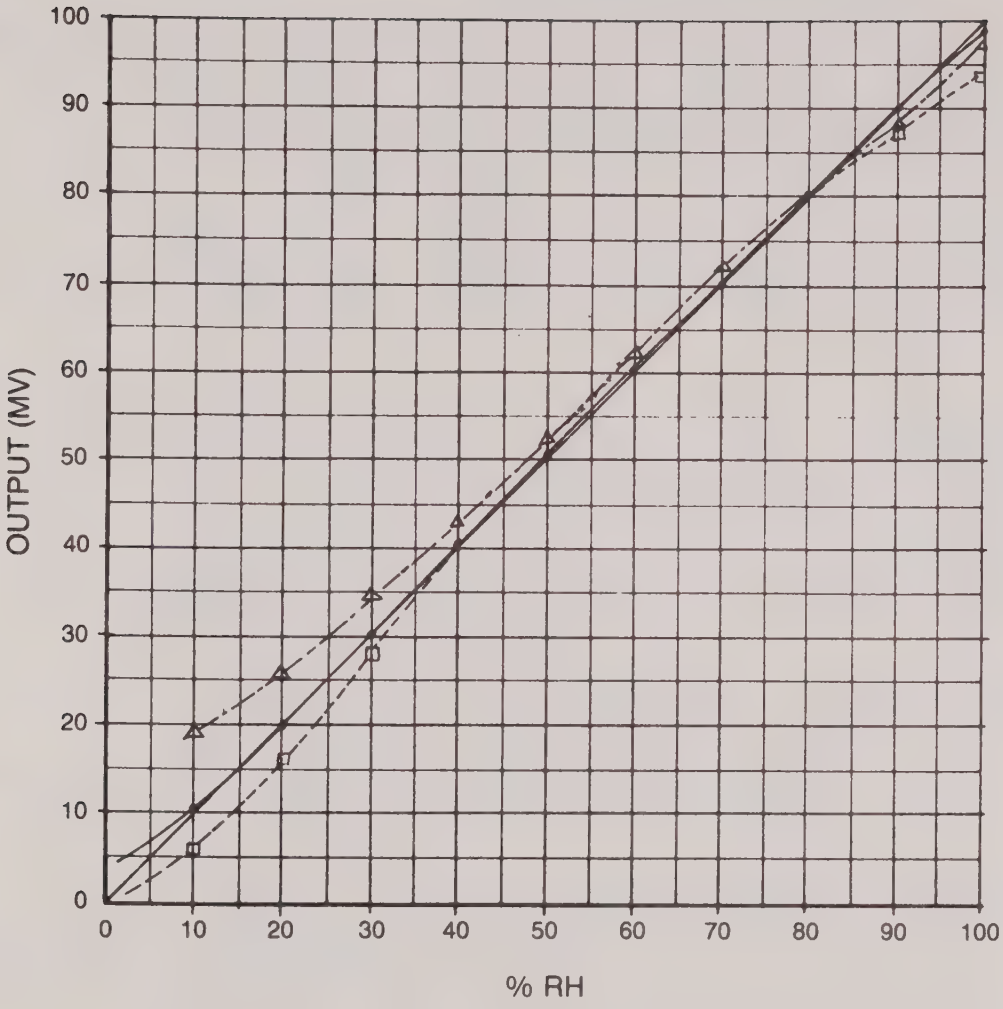



Fig. 3 Frequency Characteristics




**MODEL 800B HUMIDITY INDICATOR**
WITH MODEL 810 SENSOR

Figure 4

## 4.0 FEATURES

1. HIGH ACCURACY, HIGH RELIABILITY

   The instrument features high accuracy and excellent repeatability. It uses a very accurate and stable Polymer type bulk resistance humidity sensor, the RH-8.

   A thermistor is used for temperature measurement.

2. SMALL AND LIGHT

   Both the basic instrument and the probe are small and of light weight. A carrying case is supplied for easy portability.

3. FAST RESPONSE

   Small sensing elements for temperature and humidity provide a fast response.

4. BUILT-IN BATTERY (TWO-WAY POWER SOURCE)

   The instrument operates on 115VAC as well as on a built-in rechargeable NiCD battery, which can be used when no commercial power source is available. (approximately 8 hours continuous battery operation).

5. ANALOG OUTPUTS (STANDARD)

   Analog outputs are provided for recording or display.

   Temperature and %RH outputs are provided simultaneously and there are three output ranges to choose from.

6. EASY REPLACEMENT OF PROBE

   Probes can be easily replaced without need for recalibrating the instrument.

7. MULTI-SENSOR OPERATION

   In addition to the standard cylindrical probe, the following probes are available for use with the Model 800B: the sabre type, Model 811, stick type, Model 812, tubular type, Model 814 and oval type, Model 813.

   The connecting cable (5 feet standard) may be extended as required.

   A Model 802 switch box is available (optional) for multi channel operation (up to 5 sensors) (contact factory).

8. Temperature Compensation over 0 to 50°C range allowing accurate humidity measurements over a broad temperature and humidity range.

## 5.0 OPERATION

### 1. TEMPERATURE AND HUMIDITY MEASUREMENT

Insert the probe into the sensor connector, turn on the power switch and select either temperature or relative humidity and read the display.

To preserve the properties of the instrument for a long period of time, avoid using it at temperatures over 50°C and over 90% RH for prolonged periods of time. When the instrument is at 30% RH, the readings could be affected by external noise. (If the display is unsteady, ground the GRD terminal.)

### 2. CHARGING

When the battery runs down, "BATT" is displayed on the front panel. Start charging the battery immediately by plugging the instrument into a power outlet and turning the power switch on for a continuous charging. In this condition, the "CHG" is displayed on the front panel. The battery will be fully charged in about 15 hours and the "CHG" lamp will begin flashing on and off.

### 3. BUILT-IN BATTERY

When fully charged, the battery provides about 8 hours of measurement. When the voltage drops, "BATT" is displayed and when it drops further the display goes off. Turn the power switch off when not in use. When the battery runs down, start charging immediately.

### 4. ANALOG OUTPUTS

Temperature and Humidity outputs are simultaneous. The output ranges are switchable to 0-10mVDC, 0-100mVDC and 0-1VDC. Select the range of your choice.

The output voltage changes linearly with temperature and relative humidity, for instance:

| | | |
|---|---|---|
| Relative humidity | 0 - 100% RH | 0-100mV (100mV range) |
| Temperature | 0-50°C | 0-10mV (10mV range) |

The output impedance is less than 100Ω over the entire range.

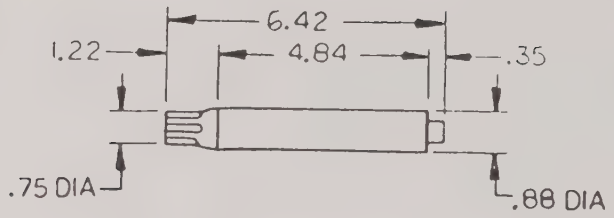
NOTE: At less than 0°C and over 50°C, an output of less than 0mV and over 10mV is obtained respectively.

### 5. STORAGE

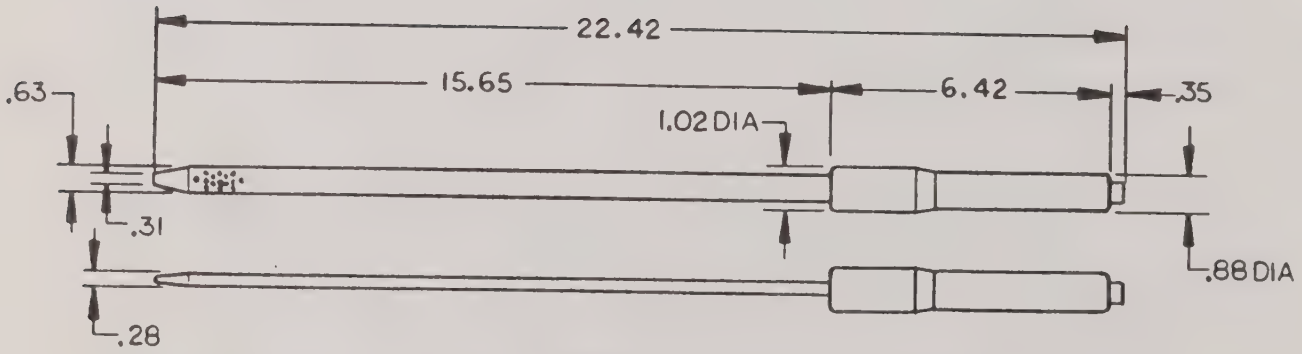
When not in use, keep the sensor in a low humidity with desiccant. A temperature of 10 to 20°C and less than 40% RH is desirable.

### 6. WARNING

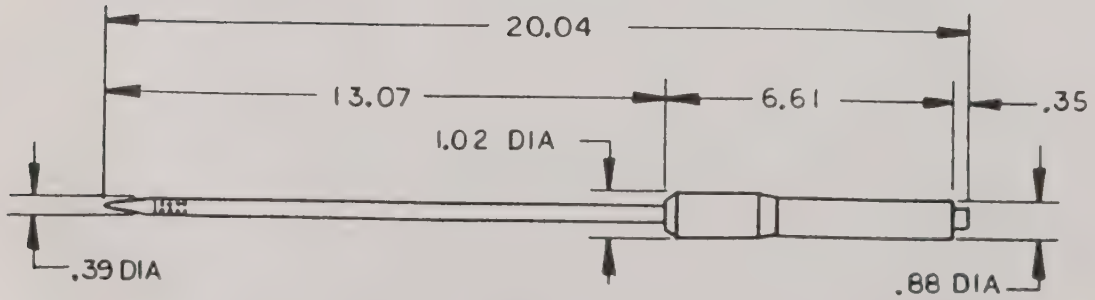
Prevent sensor exposure to water, heat or dust.



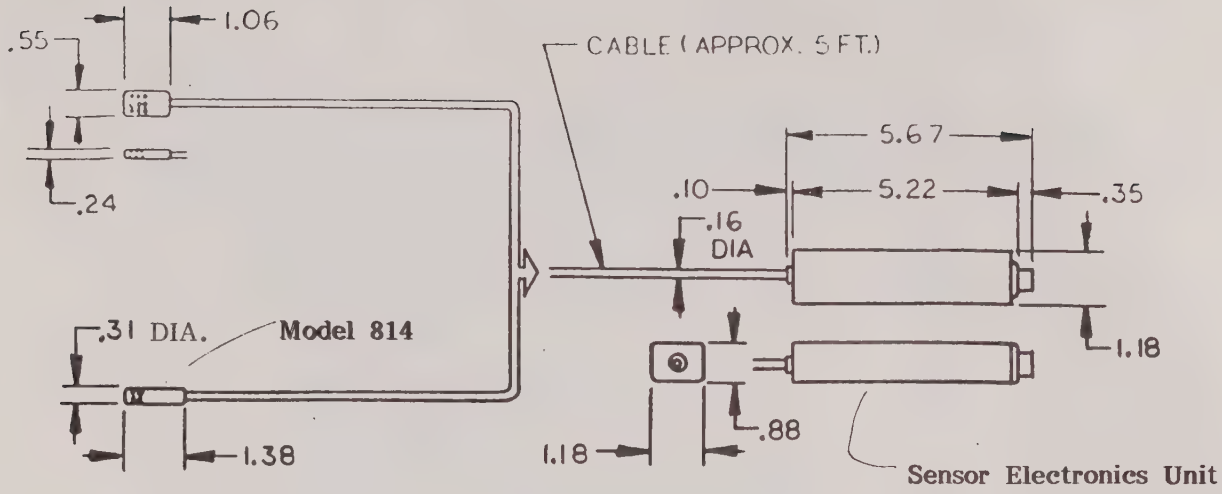

Model 810

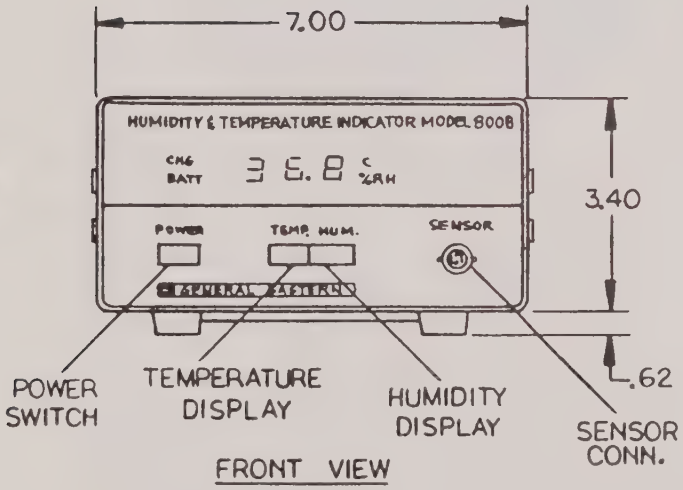


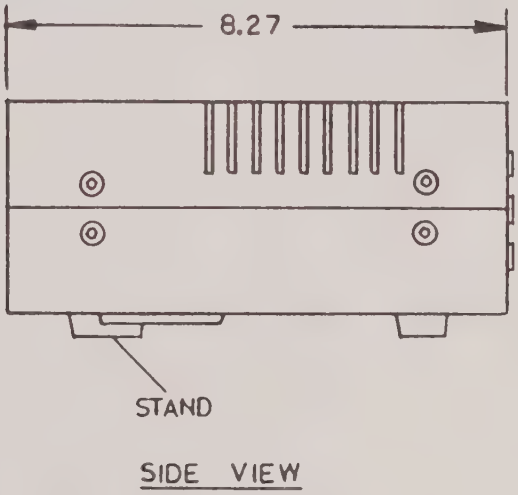

Model 811 Sensor Electronics

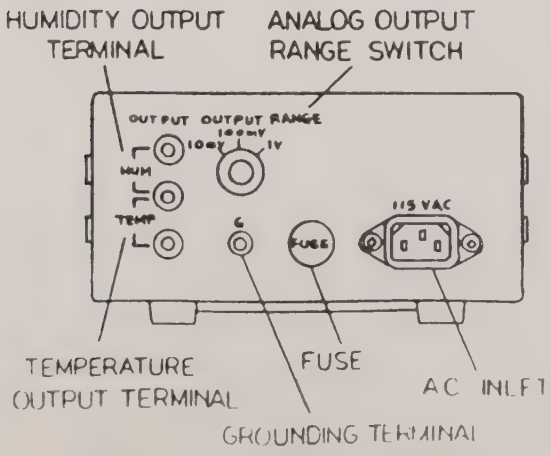



Model 812 Sensor Electronics

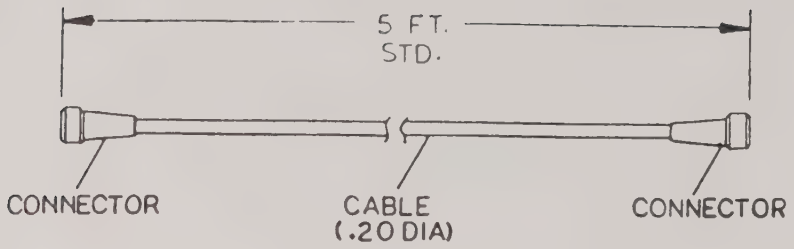



All dimensions in inches.


5 FT.
STD.
CONNECTOR
CABLE
(.20 DIA)
CONNECTOR

## 7.0 Applications

The Polymer Type Relative Humidity Sensing Elements are used in a new family of Indicators, Transmitters and Controllers, the 800-Series. Applications for this line include, but are not limited to:

- Energy Management and HVAC
- Pharmaceutical processing
- Clean rooms
- Computer rooms
- Museums and libraries
- Food, textile and paper plants
- Hospitals/medical
- Water activity measurement
- Storage of moisture-sensitive products
- Dryers
- Ovens

Like all Relative Humidity sensors, when exposed to contaminants and/or extreme environmental conditions, accuracy degradation could result. The 800-Series, while not totally immune to these effects, exhibit superior qualities as is indicated in the following tables in which results of exhaustive environmental and field tests are summarized.

**Table 1 Environmental Tests**

| Test | Conditions | Time | Change In % RH |
|---|---|---|---|
| 1. Low temperature (0°C) | At 0°C in moisture proof bag | 17 Months | -1.4% RH |
| 2. Low Temperature resistance | At -20°C in moisture proof bag | 1000 Hours | ±1% RH |
| 3. Normal temperature (25°C) | In 25°C dryer, 1 Volt rms applied | 24 Months | +2.1% RH |
| 4. High temperature (50°) | In 50°C dryer, 1 Volt rms applied | 24 Months | +3.0% RH |
| 5. Resistance to heat (80°C) | In 80°C dryer, 1 Volt rms applied | 5 Months | +6.1% RH |
| 6. Resistance to heat (100°C) | In 100°C dryer | 20 Days | +6.2% RH |
| 7. Heat resistance | At 120°C in dessicator | 1000 Hours | ±2% RH |
| 8. Temperature cycle test | 0°C (30 min.) 50°C (30 min.) | 4000 Cycles | -0.4% RH |
| 9. Temperature cycle | -20°C (30 min.) +100°C (30 min.) | 100 Times | ±2% RH |
| 10. Resistance to humidity (25°C, 90% RH) | 25°C, 90% RH in tank 1 Volt rms applied | 13 Months | +3.0% RH |
| 11. Humidity cycle | 10% RH (30 min) 90% RH (30 min) Repeat cycle @ 25°C | 1000 Times | ±2% RH |
| 12. High temperature and High humidity | 50°C, 80% RH in tank 1 Volt rms applied | 12 Months | 6.3% RH |
| 13. Standing at high temp. and high humidity | 99.9% RH and 60°C | 1000 Hours | ±2% RH |
| 14. Standing at low humidity | 20% RH or under and at room temperature | 2000 Hours | ±1% RH |
| 15. Humidity Cycle | 25°C, 40% RH (30 min.) 90% RH (30 min.) | 2000 Cycles | +3.5% |
| 16. Condensation cycle | 0% RH (10 min.) 100% RH (20 min.) Repeat at 40°C | 1000 Times | ±2% RH |

| | | | |
|---|---|---|---|
| 17. Storage test | Left in a room in sealed (silica gel) bag | 23 Months | +2.1% RH |
| 18. Resistance to gas (saturated acetone) | Saturated acetone atmosphere | 6 Months | +0.1% RH |
| 19. Resistance to gas (saturated ammonia) | Saturated ammonia gas I Volt rms applied | 9 Days | -4.6% RH |
| 20. Resistance to gas (Saturated formalin) | Formalin gas at normal temperature | 2 Months | +1.8% RH |
| 21. Resistance to gas (Saturated NaCl) | NaCl saturated solution at normal temperature | 5 Months | +2.3% RH |
| 22. Saturated water vapor | Water vapor at normal temperature | 5 Months | +2.5% RH |
| 23. Resistance to oil smoke | Atmosphere saturated with mosquito repellent incense smoke | 1 stick | +1.6% RH |
| 24. Resistance to oil | Apply salad oil by brush | One time | ±1% RH |
| 25. Resistance to oil | Impregnated with cooking oil | After 1 min. | +1.7% RH |
| 26. Solder heat resistance | 350°C; 5 sec. | 2 times | ±1% RH |
| 27. Water immersion | Room temperature | 3 minutes | ±5% RH |
| 28. Resistance to organic solvents | Stand in solution of benzene 30%, toluene 30% and xylene 40% | 2000 Hours | ±1% RH |
| 29. Resistance to formalin | Stand in solution of 10% formalin | 300 Hours | ±1% RH |
| 30. Resistance to alcohol | 50% ethanol<br>50% methanol | 300 hours<br>300 hours | ±2% RH<br>±2% RH |
| 31. Resistance to tobacco | Stand in a solution of 3 cigarettes (1,000 ml) | 60 Minutes | ±1% RH |

ENVIRONMENTAL/FIELD TESTS:

TEMPERATURE:

| | | | Calibration Change |
|---|---|---|---|
| -20°C in a moisture proof bag | | 17 months | -1.5% RH |
| 0°C in a moisture proof bag | | 17 months | -1.4% RH |
| 25°C in a dryer | | 24 months | 2.1% RH |
| 50°C in a dryer | | 24 months | 3.0% RH |
| 80°C in a dryer | | 5 months | 6.1% RH |
| 100°C in a dryer | | 20 days | 6.2% RH |
| 0°C (30 min.) | 50C (30 min.) | *4000 cycles | -0.4% RH |
| -20°C (30 min.) | 100C (30 min.) | * 100 cycles | 2.0% RH |

*includes condensation

HUMIDITY:

| | | | |
|---|---|---|---|
| 90% RH @ 25°C | | 13 months | 3.0% RH |
| 20% RH @ 25°C | | 2000 hours | 1.0% RH 3 mo. |
| 10% RH 30 min. | 99% RH @ 25°C | 1000 cycles | 2.2% RH |

GAS ATMOSPHERES:

| | | |
|---|---|---|
| Methanol saturated @ 25°C | 6 months | -0.5% RH |
| Acetone saturated @ 25°C | 6 months | 0.1% RH |
| Ammonia saturated @ 25°C | 9 days | -4.6% RH |
| Formalin saturated @ 25°C | 2 months | 1.8% RH |
| NaCL saturated @ 25°C | 5 months | 2.3% RH |
| Oil smoke "mosquito repellant" | 1 exposure | 1.6% RH |
| Water saturated @ 25°C | 5 months | 2.5% RH |

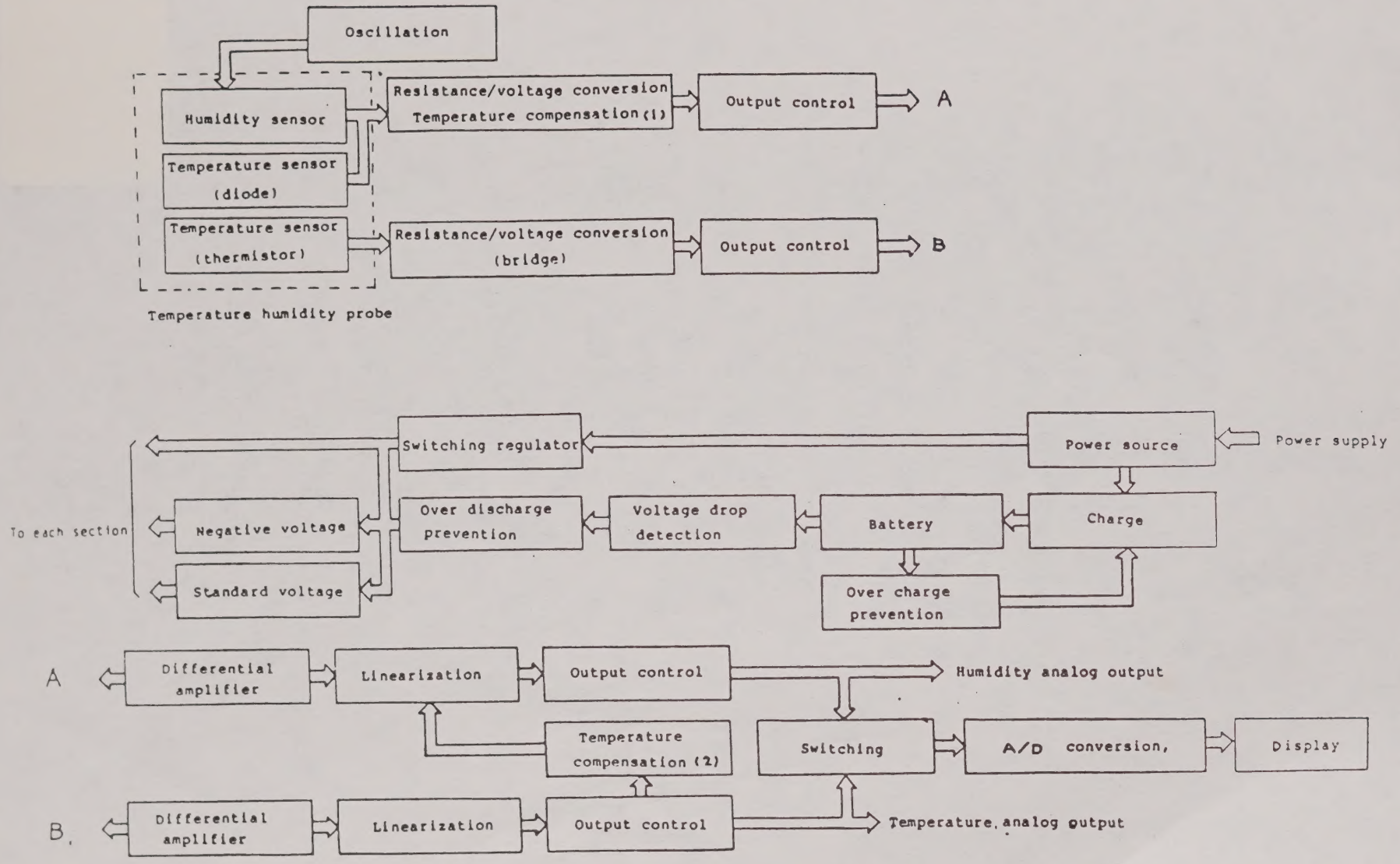
LIQUIDS @ 25°C:

| | | |
|---|---|---|
| 30% benzene, 30% toluene, 40% xylene | 300 hours | 1.0% RH |
| 10% Formalin | 300 hours | 1.0% RH |
| 50% Ethanol | 300 hours | 2.0% RH |
| 50% Methanol | 300 hours | 2.0% RH |
| Oil (salad oil) | 1 dip | 1.7% RH |
| Water | 3 min | 4.0% RH |

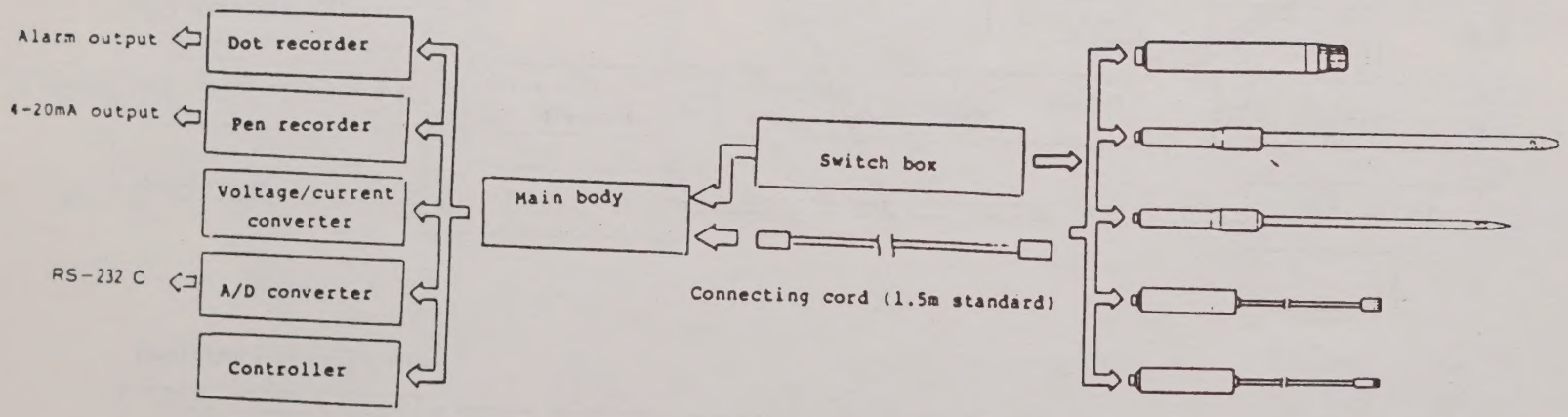
General: All humidity sensors are susceptible to contamination that will cause loss of accuracy, response time, and life expectancy.

The above tests are provided as a guide to determine the suitability of the sensor for your application. For other contaminants, please consult the factory. We at General Eastern feel that our field-proven know how, and experience-based methods can meet the demands of your requirement to measure and control Relative Humidity.

## BLOCK DIAGRAM



## System configuration (example)

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